

ASPIRE 2019

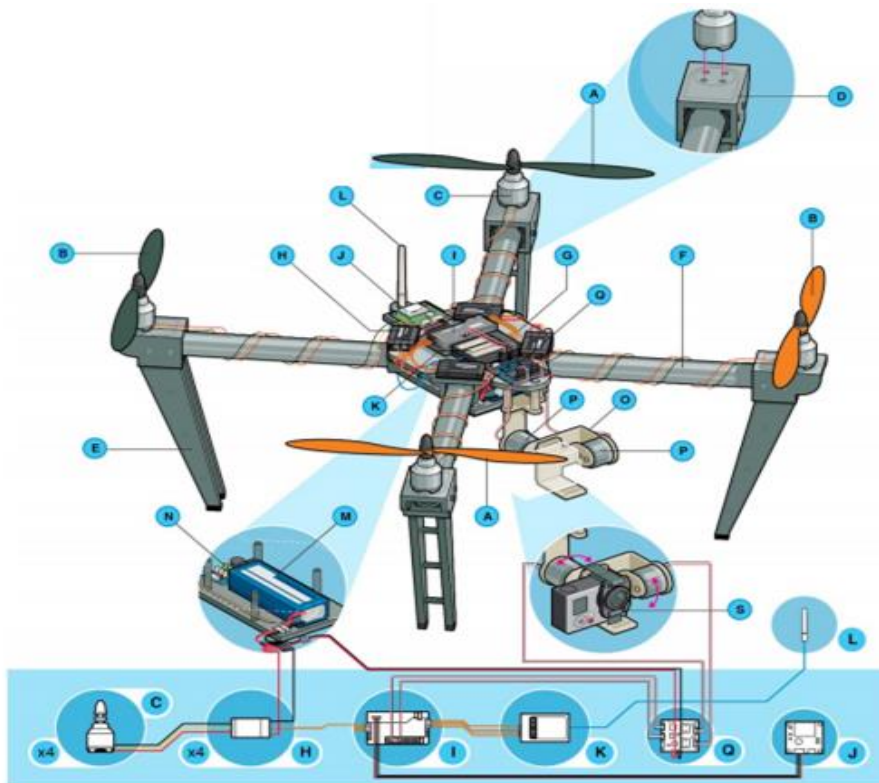


Quadcopter Introduction

- Quadcopter
 - Multi-rotor helicopter that uses four rotors to control the movement of the drone
- Movement
 - The motion is controlled by changing the rate of one or more rotors, this changes the thrust, the reaction force resulting in lifting of the quadcopter
- Uses
 - Delivery
 - Aerial Photography and Video
 - Entertainment



Quadcopter Anatomy



Propeller (Prop)
Motor
Motor Mount
Landing Gear
Boom
Main Body
Electronic Speed Controller (ESC)
Flight Controller
Receiver
Battery

Optional:
GPS Module
Antenna
Gimbal and Gimbal Motor
Camera

Project Requirements

- Motor to motor length must be less than 14 inches
- Minimum flight time of 5 minutes
- Protection: Propellor guards
- Recommendations:
 - Weight needs to be under a kilogram
 - Durable and Easy to Manufacture
 - Replaceable Parts



Motor to Motor Length

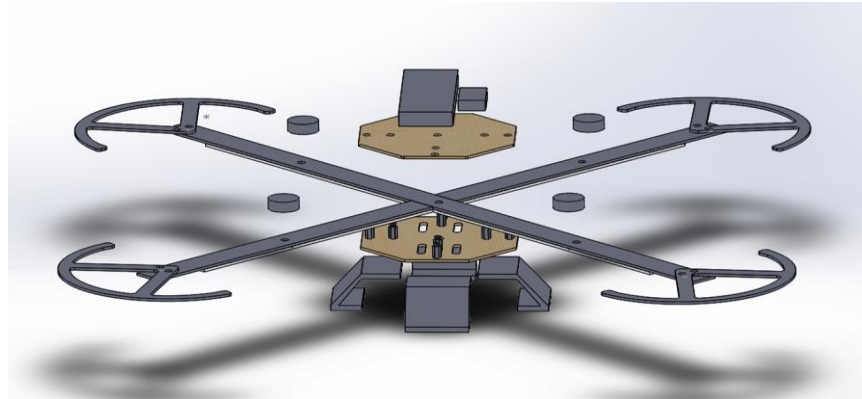


Quadcopter Curriculum Overview

1. Solidworks Fabrication
 - Create individual parts of quadcopter (arms, propeller guards, landing gear, etc)
 - Assemble the parts in Solidworks
1. Structural Fabrication
 - Material Selection
 - Fabrication of parts
 - Assembly of Chassis
1. Electrical Fabrication
 - Soldering
 - Wiring
1. Controls
 - Pitch, Roll, Yaw, Elevation
 - Piloting
1. Calibration
 - ESC
 - NAZA

Solidworks Fabrication

- Fabricate all individual parts(take into account the requirements of project
 - Allows for easily editing the dimensions of the parts
 - Easier than making the entire quadcopter as one part
- Use assembly in Solidworks to build the quadcopter CAD model
- All parts must be on the same device to make the complete assembly in Solidworks.



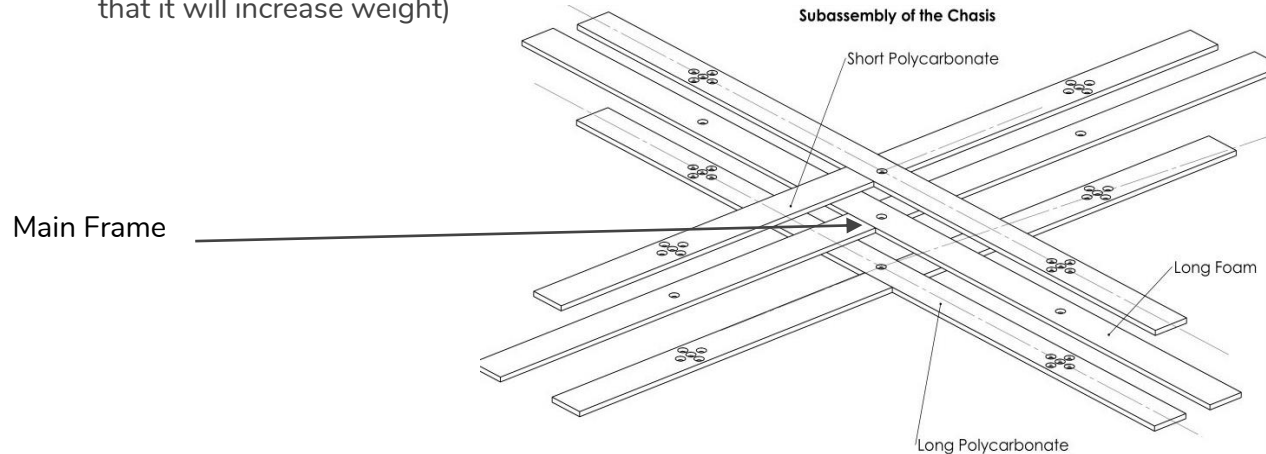
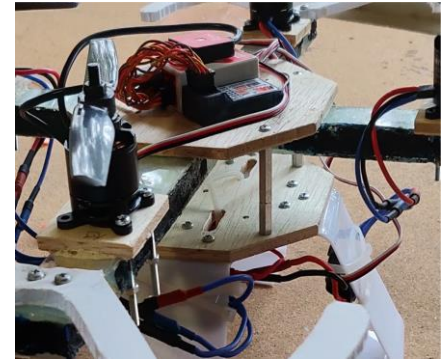
Materials

- ½" Polystyrene Foam
- ¼" Coroplast (Corrugated Plastic)
- ¼" Birch Wood
- ⅛" Polycarbonate
- 1/16" Polycarbonate
- 3D Printing Material



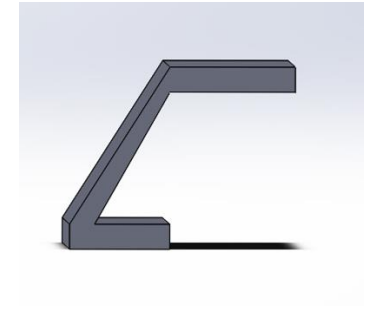
Structural Fabrication 1/2

- Fabrication of Main Body
 - Where the NAZA, Battery, Receiver, and wiring harness will be mounted
 - Location of Center of Mass
 - Recommended materials: Wood, Coroplast
 - **Must be Sturdy**
- Fabrication of Arms:
 - Sturdy ones are recommended as it improves stability and will be less likely to break
 - Should be wide enough to allow for the mounting of the motors (at least 1 inch in width)
 - Recommended materials: Polycarbonate or Coroplast
 - Can use Sandwich design with various materials stacked for extra strength (Be aware that it will increase weight)





Structural Fabrication 2/2



- Fabrication of Propeller Guards
 - Guards must extend at least .5 inch from propellers
 - All propellers must have protective guards covering at least 25% circumferential distance and extending at least 0.5 inches beyond the tip of the propeller.
 - Recommended material: Coroplast or Polycarbonate
- Fabrication of Landing Gear
 - Landing Gear should be made from a durable material that will withstand drops.
 - **Wood is not recommended**
 - Examples:
 - -Use Polycarbonate and bending it
 - -Stacking foam





Structural Assembly

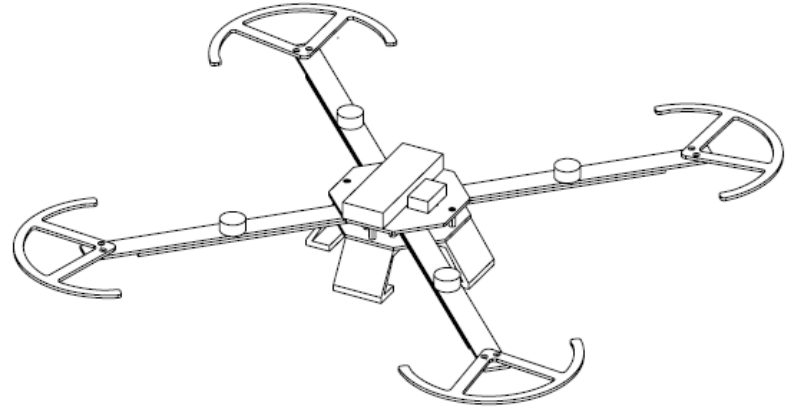
Two ways to Assemble Parts:

1. Using Screws (Recommended)

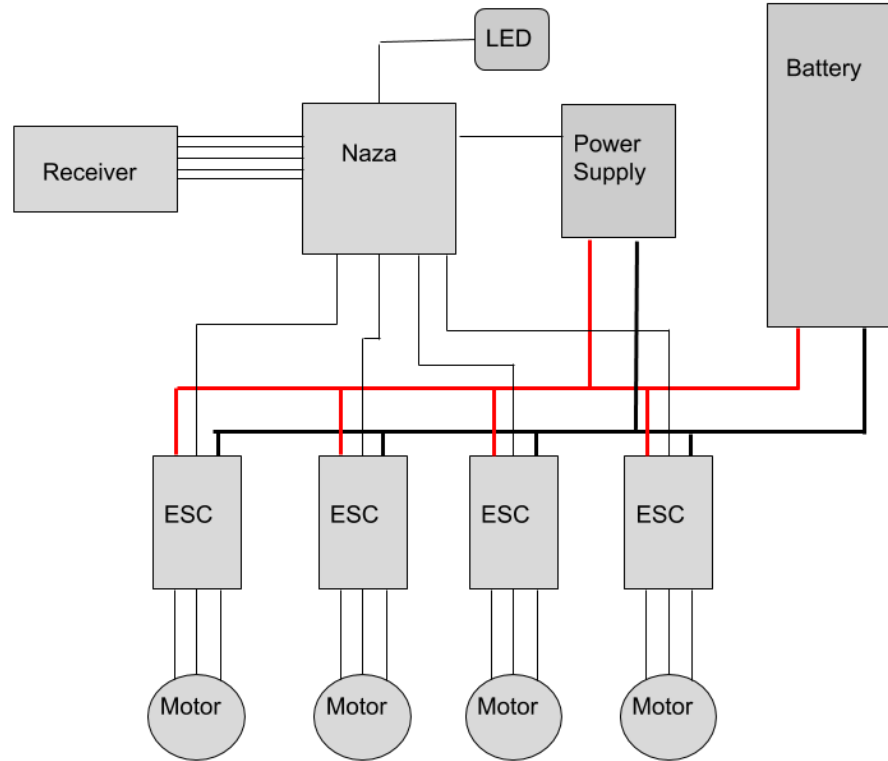
- Allows for parts to be removed and replaced easily
- Fast to Assemble

2. Using Glue

- Takes longer, have to wait for quadcopter to dry
- Cannot replace all parts as easily

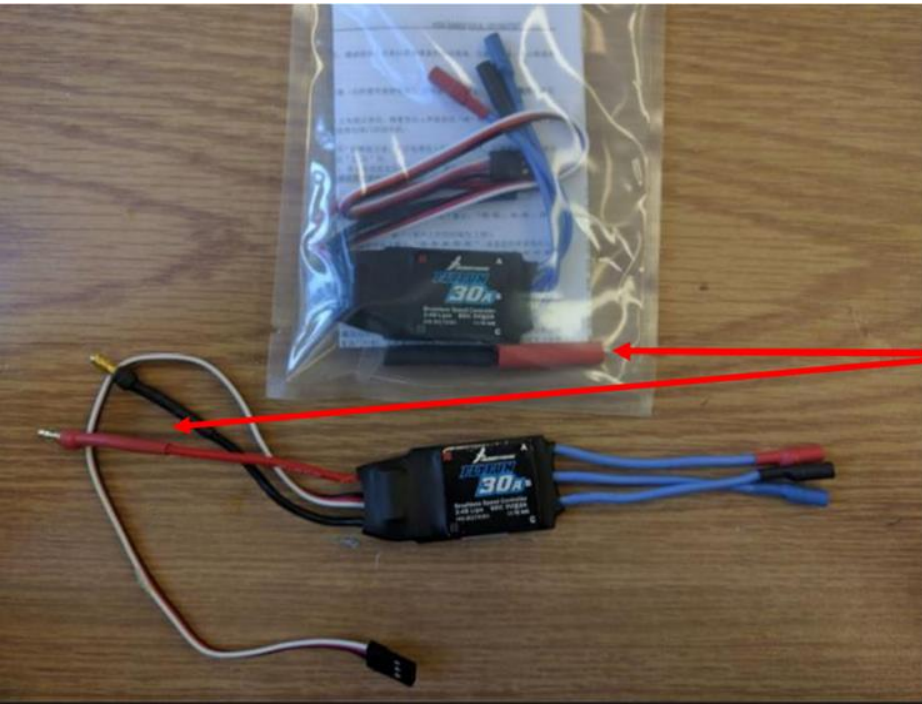


Electrical Fabrication - Wiring



Electronic Fabrication - ESCs

ESC - Electronic Speed Controller

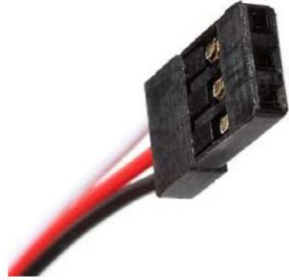


1. Solder male bullet connectors to wires
2. Heat shrink covers to bullet connectors

Red Heat Shrink Added to **Red** Wire

Black Heat Shrink Added to **Black** Wire

ESC Components

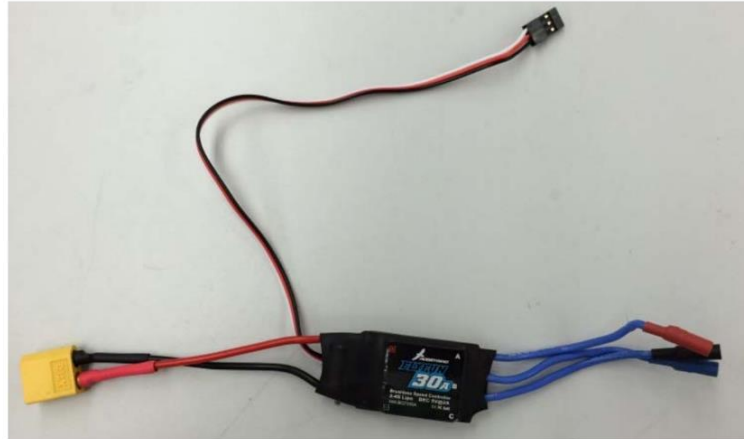


Signal from NAZA

White: Signal (PWM)

Red: 5 Volts

Black: Ground (0 Volts)



From
Battery

To Motor

Max Current: 30 A

Electronic Fabrication - Motors

1. Solder male bullet connectors to 3 motor wires
2. Heat shrink covers to bullet connectors

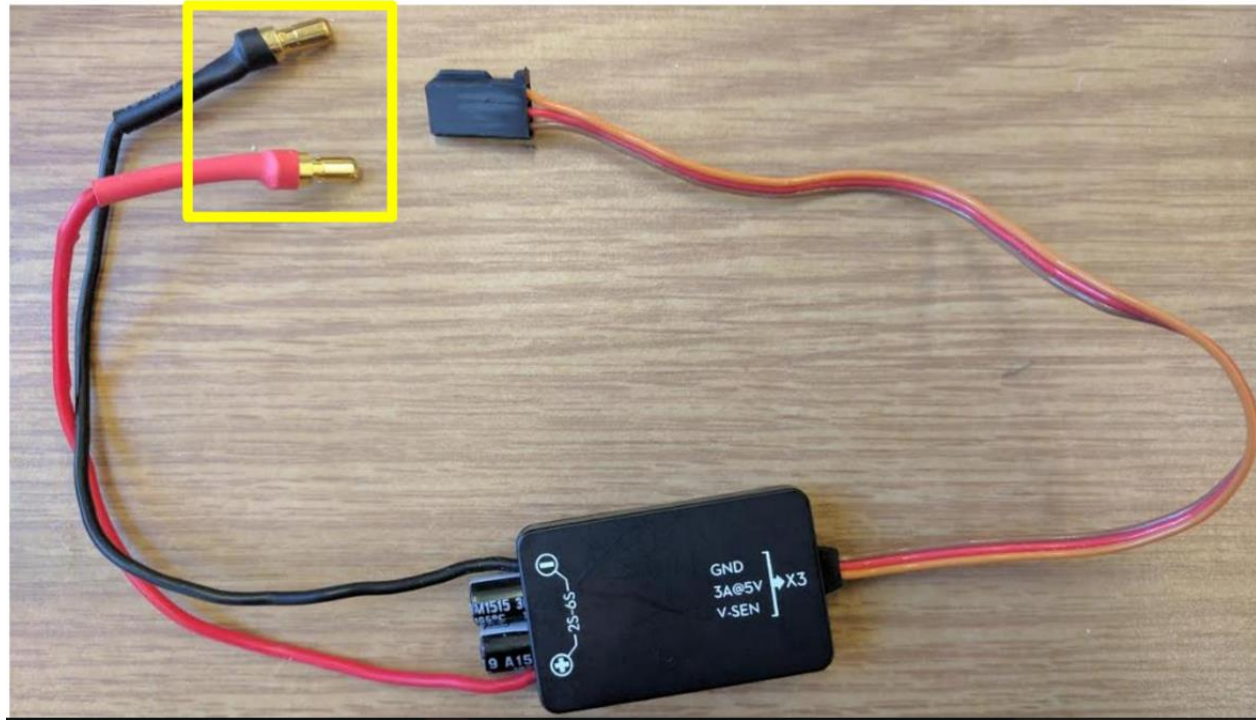
BAD...

GOOD!



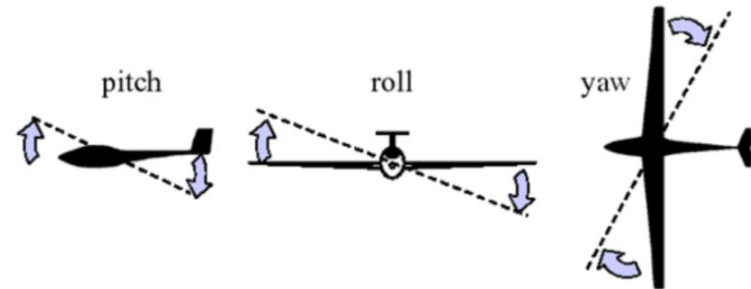
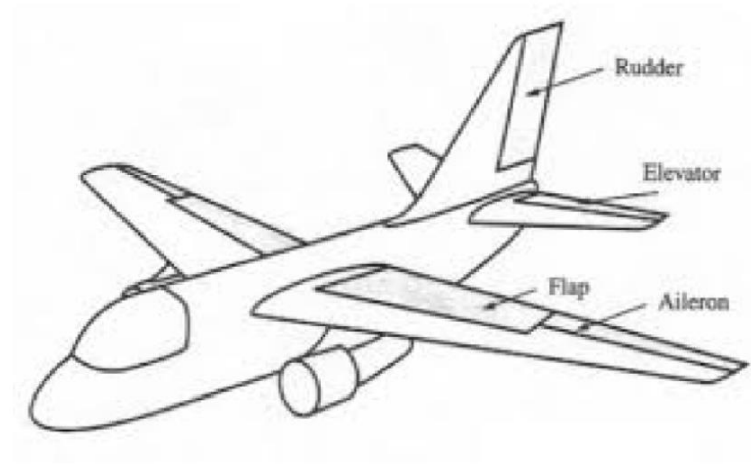
Electronic Fabrication - NAZA Voltage Regulator

1. Solder male bullet connectors to power wires
2. Heat shrink covers to bullet connectors



Controls and Piloting - Aircraft Dynamics

- Elevator (Pitch) - Forward/Backward
- Aileron (Roll) - Right/Left
- Rudder (Yaw) - Spin
- Throttle (Altitude) - Up/Down



Controls and Piloting - NAZA Controller

Quadcopter Flight Controller →

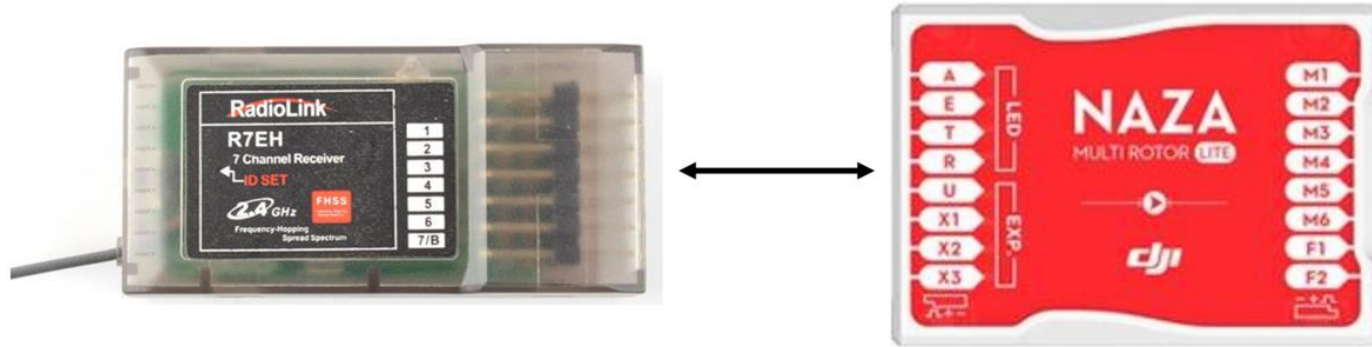
Right Handed
Transmitter
Configuration

Connect to the receiver, which
receives commands from the pilot



1. Ailerons (Roll)
2. Elevators (Pitch)
3. Throttle (Altitude)
4. Rudder (Yaw)
5. U (Failsafe)

Controls and Pricing - NAZA Connection



Regular (Originally **Right** Handed) Transmitters

- 1 → A
- 2 → E
- 3 → T ** Use channel 3 for ESC calibration
- 4 → R
- 5 → U

Modified (Originally **Left** Handed) Transmitters

- 1 → A
- 2 → T ** Use channel 2 for ESC calibration
- 3 → E
- 4 → R
- 5 → U

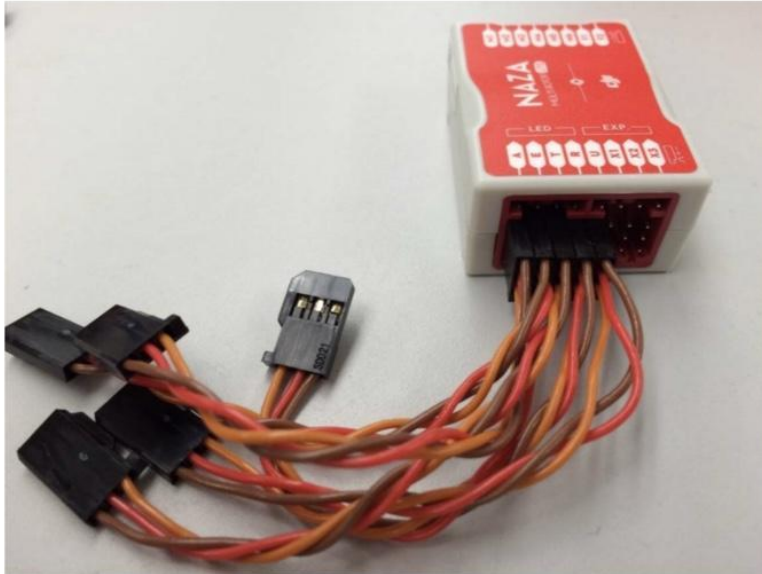
NAZA Flight Controller Basic Structure



- Translates pilot input into motor control
- Orientation control w/ collection of sensors
 - Pressure sensor (Altitude)
 - Gyroscope (Roll, Pitch, Yaw)
 - Accelerometer (Linear Acceleration)
 - Magnetometer (Compass)
 - GPS (Not Needed)

Controls and Pricing - NAZA Connection

Connect the servo-type connectors to the flight controller ports labeled A, E, T, R, U.



- A: Aileron
- E: Elevator
- T: Throttle
- R: Rudder
- U: Failsafe switch

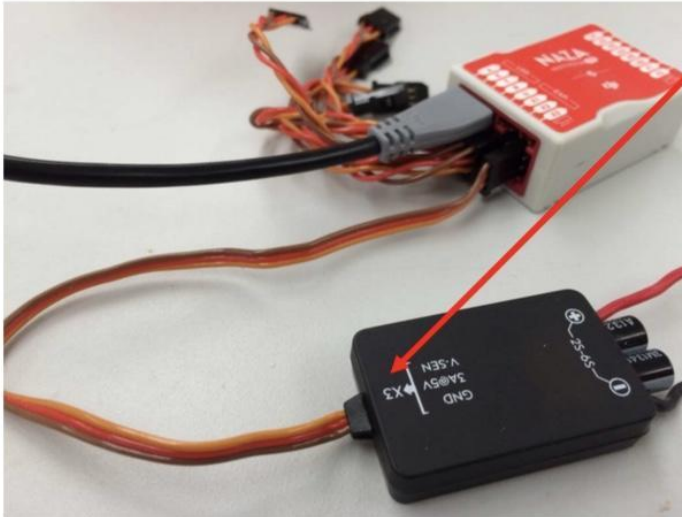
GROUND WIRE ON TOP

Controls and Pricing - NAZA Connection



Controls and Pricing - NAZA Connection

Connect the voltage regulator to the **X3** port
GROUND WIRE ON TOP



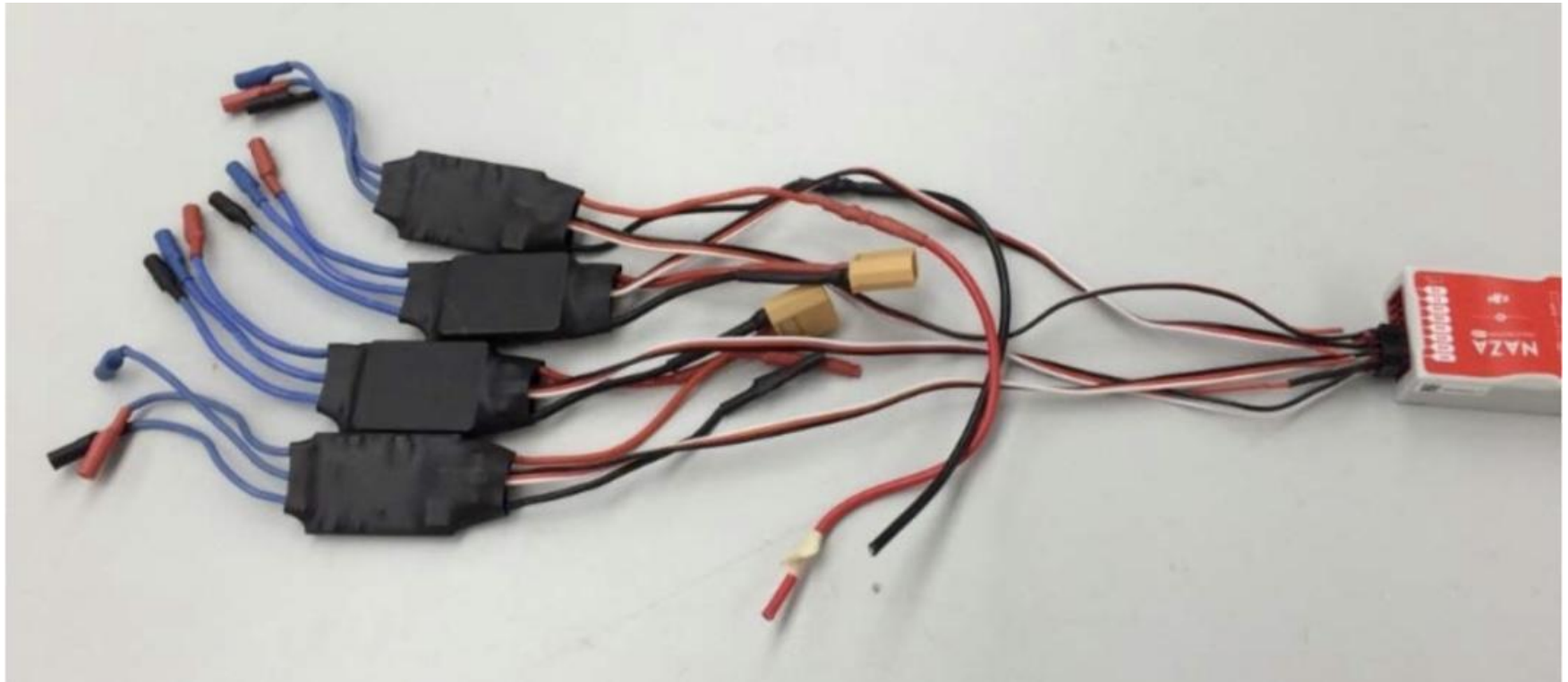
Provides a regulated 5v supply voltage to flight controller

→ Other two leads connect to the battery.

Controls and Pricing - NAZA Connection



Controls and Pricing - NAZA Connection

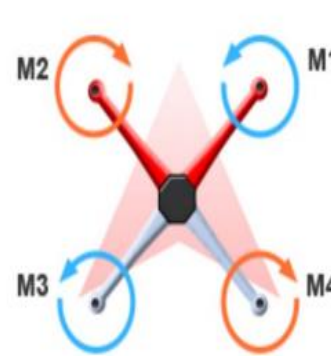




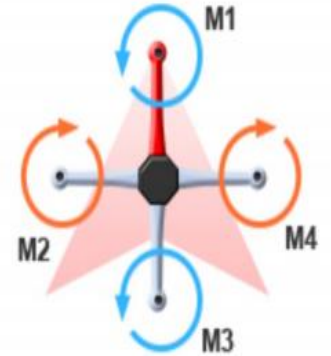
Calibration - Motor Direction

M1: The first motor from the front of quadcopter

1. In NAZA software, set the configuration to X or +
2. Label each motor and set each to its correct direction
3. Set M1 and M3 to CCW, to change direction, any two of three wires of ESC
4. Set M2 and M4 to CW
5. Test direction of each motor, if it follows the diagram of your selected configuration, then it has been done correctly.



Top view with
a X Configuration



Top view with
a Cross or Plus Configuration



Calibration - ESCs

1. Plug ESC to motor
2. Plug ESC signal wire to receiver throttle channel
3. Turn on transmitter
4. Move throttle stick to top position
5. Plug battery to ESC (3 tone startup sound)
6. Listen for 2 short tones then move throttle stick position down to bottom
7. Listen for 3 short tones and 1 long tone
8. Complete

Calibration - ESCs

Throttle Channel
Ground Wire **DOWN**

Switch any two wires
to **change** direction
of motor



Good Bullet Connector Coverage



Calibration - NAZA

1. Fully assembled quadcopter, check wiring before receiving battery
2. Plug in LED on quadcopter using USB cord to computer
3. Turn transmitter ON and failsafe ON
4. Plug in battery to quadcopter during installation
5. Install software <https://www.dji.com/naza-m-lite/download>



Assistant Software & Driver



Naza-M Lite Assistant Software v1.00

📅 2014-04-22

* Download the Firmware via Assistant software; the software only supports Windows XP or above (32bit/64bit).

@Naza-M Lite Firmware* v1.00



DJI WIN Driver Installer

📅 2013-01-18

supports Windows XP or above (32bit/64bit).



Naza-M Lite Assistant Software v1.00

📅 2014-04-22

* Download the Firmware via Assistant software. Mac OS X 10.9 or above.

PC Computer

MAC Computer



View



Basic



Advanced



Tools



Upgrade



Info

Basic**Mounting**

GPS Location

X 0 cm

Y 0 cm

Z 0 cm

Aircraft

Mixer Type: NONE

RC

Receiver Type NONE

Gain

Pitch

Roll

Yaw

Vertical

Basic 100% INH ▾

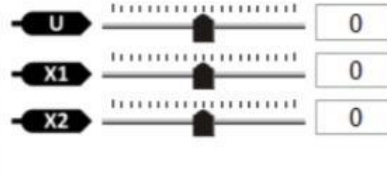
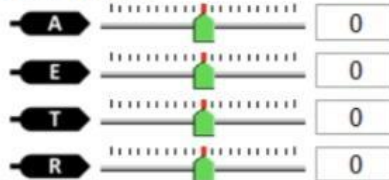
100% INH ▾

100% INH ▾

100% INH ▾

Attitude 100% INH ▾

100% INH ▾

Channel Monitor[OnLine Help](#)**Advanced****Motor**

Motor Idle Speed: NONE

Cut Off Type: NONE

F/S

Failsafe Methods: NONE

IOC

Intelligent Orientation Control NONE

Gimbal

Gimbal Switch: NONE

Voltage

Protection Switch NONE

Current Voltage: NONE

Battery Type: NONE

First Level Protec NONE

Second Level Protec NONE



MODE:

N/A

MC OUTPUT:

ON

Thank You

